

OFF-SITE GROUNDWATER INVESTIGATION REPORT

**HARDESTY FEDERAL COMPLEX
601-607 HARDESTY AVENUE
KANSAS CITY, MISSOURI**

July 12, 2004

Burns & McDonnell Project No. 36204

**Burns & McDonnell Engineering Company, Inc.
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SUBMITTAL CERTIFICATION

Submittal Description: Off-Site Groundwater Investigation Report, Hardesty Federal Complex,
601-607 Hardesty Avenue, Kansas City, Missouri

I certify that the above submittal was prepared under my supervision according to current geological practice, and that to the best of my knowledge it is complete and accurate.

Signed: Tracy L. Cooley

Registration No.: RG 0419



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1.0 INTRODUCTION

1.1 GENERAL

Upon request of General Services Administration (GSA), Burns and McDonnell Engineering Company, Inc. (Burns & McDonnell) completed an off-site groundwater investigation for the Hardesty Federal Center located at 601-607 Hardesty Avenue in Kansas City, Missouri (Site) (see Figure 1). The investigation was conducted within residential/commercial areas located north and east of the Site.

1.2 INVESTIGATION PURPOSE AND OBJECTIVES

The overall purpose of the off-site investigation was to evaluate the potential presence of impacted groundwater that may be associated with former activities at the Hardesty Federal Center.

The investigation activities were conducted specifically to achieve the following objectives:

- Determine the magnitude and extent, both vertically and laterally, of off-site volatile organic compound (VOC) contamination in groundwater.
- Evaluate potential off-site human health risks due to groundwater contamination.
- Develop an initial list of remedial options for off-site groundwater contamination, if necessary.
- Evaluate on-site remedial options for existing on-site contamination.

1.3 REPORT ORGANIZATION

This Investigation Report is organized in the following manner:

- Section 1.0 outlines the project purpose and objectives of the investigation along with a review of previous Hardesty Federal Center investigations.
- Section 2.0 summarizes the specific field activities conducted for the investigation.
- Section 3.0 consists of a summary of the investigation results
- Section 4.0 provides the off-site risk evaluation.
- Section 5.0 provides conclusions derived from the investigation.
- Section 6.0 provides the off-site remediation evaluation.
- Section 7.0 consists of the references noted in this report.

The following appendices are located after the main text of the report:

- Appendix A – Investigation Work Plan

- Appendix B – Environmental Priority Service Analytical Reports
- Appendix C – Analytical Management Laboratory Analytical Reports
- Appendix D – Geotechnology Analytical Reports

1.4 SUMMARY OF INVESTIGATION APPROACH

The letter entitled Work Plan for Off-Site Groundwater Investigation Hardesty Federal Center, dated April 19, 2004 (Burns & McDonnell, 2004), was prepared to define the scope of work and procedures to be followed for the investigation. The letter document served as the Work Plan for the investigation. A copy of this letter is provided in Appendix A of this report.

Field investigation activities were completed according to the Work Plan from May 10, 2004 through May 13, 2004. Activities conducted during the field investigation included direct push sampling for collection of subsurface soil, soil gas, and groundwater samples. Off-site groundwater samples were collected at locations north and east of the Site to evaluate potential VOC contaminant migration exceeding *Missouri Department of Natural Resources (MDNR) Cleanup Levels for Missouri (CALM) Groundwater Target Concentrations (GTARC)* (MDNR, 2001). Off-site groundwater locations were selected based on hydrogeologic conditions of the Site and previous investigation results. One subsurface soil sample was collected from a location upgradient of the Site for risk evaluation purposes. In addition, soil gas samples were collected from two on-site locations in the northeast corner of the Site to evaluate a potential additional source of contamination. All investigation activities were completed following methods and procedures described in the Work Plan.

1.5 PREVIOUS INVESTIGATIONS / REPORTS

Prior to conducting the investigation a review of available reports was conducted to provide useful background data and help determine previous extent and historical levels of any localized contamination. A review of the following two documents was conducted.

Off-Site Groundwater Investigation Report

A review of data provided in the September 9, 2003, *Off-Site Groundwater Investigation Report* (Terracon, 2003a) was conducted to provide historical off-site groundwater information. Groundwater sampling was conducted at off-site locations northeast of the Site boundaries.

Groundwater data provided in the report indicated the presence of VOC contamination off-site to the northeast. VOCs detected during the investigation included trichloroethene (TCE), cis-1,2-dichloroethene (cis-1,2-DCE), and naphthalene. Of the VOCs detected, only TCE exceeded the MDNR CALM GTARC

action levels. TCE concentrations within off-site groundwater ranged from 4.4 micrograms per liter ($\mu\text{g/L}$) to 229 $\mu\text{g/L}$.

On-Site Groundwater Investigation Report

The *On-Site Groundwater Investigation Report* completed by Terracon dated August 20, 2003 (Terracon, 2003b) was also reviewed prior to the investigation to provide additional data.

Groundwater data provided in the report indicated the presence of VOC contamination on-site. VOCs commonly identified in groundwater included 1,1-dichloroethene (1,1-DCE), cis-1,2-DCE, trans-1,2-dichloroethene (trans-1,2-DCE), 1,1,2,2-tetrachloroethane (PCA), tetrachloroethene (PCE), 1,1,2-trichloroethane (TCA), TCE, chloroform and vinyl chloride. Of the VOCs detected, 1,1-DCE, PCA, PCE, TCA, TCE, and vinyl chloride were detected above the MDNR CALM GTARC levels, with PCA and TCE being detected most frequently.

According to the soil data collected during the *On-Site Groundwater Investigation Report*, soil samples collected above the groundwater table did not appear to be impacted above the MDNR CALM soil target concentration (STARC) and Leaching to Groundwater values.

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2.0 FIELD INVESTIGATION

2.1 GENERAL

The overall objective of the investigation was to collect data necessary to further define and evaluate off-site groundwater contamination migrating from the Site. The field investigation focused on areas to the north and east where previous investigations have identified off-site groundwater contamination and where contaminants were likely to migrate based on the geologic and hydrogeologic conditions of the area. This section presents details of specific field activities performed to achieve project objectives.

Field investigation activities were conducted following procedures described in the Work Plan (Burns & McDonnell, 2004). Direct-push drilling was utilized to conduct field investigation activities. These activities included:

- Groundwater Sampling
- Soil Gas Sampling
- Subsurface Soil Sampling (for risk evaluation purposes)
- On-site Analysis of Contaminants of Concern
- Laboratory Confirmation Analysis

Contaminants of concern (COCs) consist of cis-1,2-DCE, PCE, and TCE.

2.2 INVESTIGATION ACTIVITIES

A total of 16 direct push borings were completed for the collection of off-site groundwater samples (see Figure 2). Of the 16 direct push borings completed, only nine locations accumulated enough groundwater to be sampled. Groundwater samples were collected from SP-1, SP-4, SP-5, SP-6, SP-7, SP-8, SP-9, SP-10, and SP-16. Sample locations SP-2, SP-3, SP-11, SP-12, SP-13, SP-14 and SP-15 were dry and unable to be sampled.

Samples were collected from two distinct depth intervals, where possible, to determine vertical distribution of potential groundwater contamination; the shallow zone (located within the first 10 feet of groundwater encountered) and the deep zone (located within the last 10 feet of groundwater above refusal). A total of 12 groundwater samples were collected and analyzed on-site using a field gas chromatograph (GC). Both shallow and deep zone samples were collected from locations SP-1, SP-4, SP-7, and SP-10. Due to low sample recovery and/or shallow groundwater thickness, only one groundwater sample was collected from locations SP-5, SP-6, SP-8, SP-9, and SP-16. At sample

locations SP-8 and SP-9, the borehole was left open overnight to accumulate enough groundwater for sample collection. Samples collected from SP-8 were submitted for off-site laboratory analysis only, as the on-site laboratory had demobilized the previous day. Samples collected from SP-9 were analyzed by both the on-site and off-site laboratories. All groundwater samples collected for on-site analysis were analyzed for cis-1,2-DCE, TCE, and PCE.

In addition to on-site analysis, split groundwater samples were sent to an off-site analytical laboratory for confirmation VOC analysis (by method 8260) at a rate of one per every four samples collected. A total of 4 groundwater samples were submitted for off-site laboratory analysis during the investigation.

Soil gas samples were also collected from the northeast corner of the Site to evaluate the potential presence of an additional on-site source. Soil gas samples were collected from two on-site locations, SG-1 and SG-2, at depths of 8-10 feet below ground surface (bgs) and 15-17 feet bgs at each location (see Figure 2). Soil gas samples were analyzed by the on-site GC for cis-1,2-DCE, TCE, and PCE.

Geotechnical samples were also collected from one sample location for risk evaluation purposes. One bulk soil sample was collected from the 8-12 foot interval at location BH-1 for off-site laboratory analysis of water content, total organic carbon (TOC), and dry bulk density.

The direct-push borings and on-site analysis were completed by Environmental Priority Service, Inc. (EPS) of Salina, Kansas. Off-site confirmation analysis of groundwater was performed by Analytical Management Laboratories (AML) in Olathe, Kansas. Geotechnical sample analysis was performed by Geotechnology in Lenexa, Kansas.

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3.0 INVESTIGATION RESULTS

3.1 GENERAL

This section describes the results of the investigation, including geology/hydrogeology information, and analytical results of groundwater, soil gas, and geotechnical samples collected during investigation field activities. Quality Assurance / Quality Control (QA/QC) is also described in this section.

3.2 GEOLOGY / HYDROGEOLOGY

During the investigation, the occurrence of groundwater within the vicinity of the Site was variable in nature. Sufficient groundwater for sample collection was encountered at only 9 of the 16 sample locations. Sample points located east / southeast of the Site yielded little to no groundwater for sample collection. This area, which includes sample points SP-2, SP-3, SP-8, SP-9, SP-12, SP-13, SP-14, and SP-15, is located within a topographic upland exhibiting shallow bedrock elevations, ranging from 10 to 34 feet bgs. Sample points located northeast of the Site yielded sufficient groundwater for sample collection, indicating that the majority of groundwater flow within the vicinity of the Site occurs toward this direction.

During the investigation, bedrock was encountered at 15 of the 16 sample locations at depths ranging from 10 feet to 60 feet bgs. Bedrock was not encountered at location SP-11, which was probed to a total depth of 60 ft bgs. In general, bedrock was identified at relatively shallow depths east of the Site and relatively deeper depths northeast of the Site.

An evaluation of groundwater flow beneath the Site was conducted by collecting water level measurements from the existing monitoring wells located on-site. Based on this data, groundwater beneath the Site appears to flow in an east-northeast direction.

3.3 INVESTIGATION DATA

The majority of the investigation data was derived from on-site analysis conducted by EPS in their mobile laboratory. All off-site groundwater analysis was performed by AML in their Olathe, Kansas laboratory. Geotechnical analysis was performed by Geotechnology in their Lenexa, Kansas laboratory. Copies of the analytical reports submitted by EPS, AML, and Geotechnology are provided in Appendices B, C, and D, respectively.

3.3.1 Groundwater Data

Groundwater sampling was completed at specified locations to determine the potential extent of COCs in groundwater. Samples were collected from two distinct depth intervals, where possible, to determine vertical distribution of potential groundwater contamination; the shallow zone (located within the first 10 feet of groundwater encountered) and the deep zone (located within the last 10 feet of groundwater above refusal). A total of 12 groundwater samples were analyzed on-site for cis-1,2-DCE, PCE, and TCE. In addition, four groundwater samples (three as confirmation analysis) were analyzed at an off-site laboratory for VOCs (method 8260). Analytical results for both on-site and off-site groundwater samples, including sample depths, are summarized in Tables 1 and 2, respectively. A map detailing total TCE concentrations within groundwater is provided as Figures 3.

TCE levels were identified from on-site analysis at two sample locations. The deep groundwater sample interval from location SP-4 indicated a TCE concentration of 34.7 µg/L. TCE was also identified in groundwater from the shallow sample interval at location SP-5 at a concentration 5.6 µg/L. Both TCE detections exceed MDNR CALM GTARC action levels. A confirmation sample was collected at location SP-5, which also indicated a TCE detection of 6.5 µg/L. No other TCE detections were identified during the investigation.

Cis-1,2-DCE was non detect at all sample locations with the exception of the sample location SP-1. The shallow groundwater sample collected from location SP-1 indicated a concentration of 1.6 µg/L. No other cis-1,2-DCE detections were identified during the investigation..

PCE was not identified in any on-site or off-site groundwater sample collected during the investigation.

3.3.2 Soil Gas Data

Soil gas samples were collected from the northeast corner of the Site to evaluate the potential presence of an additional on-site source. Soil gas samples were collected from two on-site locations, SG-1 and SG-2, at depths of 8-10 feet bgs and 15-17 feet bgs at each location. A total of four soil gas samples were analyzed by the on-site GC for cis-1,2-DCE, TCE, and PCE.

No detections were identified in any of the soil gas samples.

3.3.3 Geotechnical Data

Geotechnical samples were collected to aid in evaluating risk for the Site. A bulk soil sample was collected from an up-gradient location, BH-1, and analyzed for bulk density, moisture content, and TOC.

The sample was collected from a depth of 8-12 feet and submitted to the off-site laboratory within a sealed four foot acetate liner.

Geotechnical results indicated a volumetric water content of 0.419 cubic centimeter per cubic centimeter (cc/cc), a dry bulk density of 1.581 gram per cubic centimeter (g/cc), a porosity of 0.586 cc/cc, and a TOC of 0.001 gram per gram (g/g). These data are used in the off-site risk evaluation presented in Section 4.0.

3.4 QUALITY ASSURANCE / QUALITY CONTROL

Quality assurance and quality control (QA/QC) for this sampling event was conducted by completion of a rinsate sample and trip blanks.

One rinsate sample was collected during the investigation to evaluate decontamination procedures. Deionized water was poured over the downhole sampling equipment used during the direct push investigation and into appropriate sample containers. The rinsate sample was analyzed on-site for cis-1,2-DCE, TCE, and PCE. No detections were observed in the rinsate sample, therefore, the decontamination procedures followed during the investigation were conducted appropriately.

One set of trip blanks (provided by AML) were placed within each cooler containing groundwater samples submitted for off-site laboratory analysis. No VOCs were detected in either trip blank sample, therefore, it does not appear cross contamination occurred.

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4.0 OFF-SITE RISK EVALUATION

4.1 GENERAL

The off-site investigations conducted in 2003 and 2004 identified the presence of site-related constituents in off-site groundwater; therefore, a risk evaluation was completed to assess whether the concentrations of chemicals in off-site groundwater pose unacceptable risks to human health. The purpose of the risk evaluation was to develop site-specific target levels (SSTLs) for groundwater that are protective of human health and the environment. This section of the report describes the methodology, equations, and variables that were used in the evaluation. The results of the evaluation are provided at the end of this section.

4.2 METHODOLOGY

Site-specific SSTLs were developed according to standard risk assessment methodologies as put forth in United States Environmental Protection Agency's (USEPA) *Risk Assessment Guidance for Superfund (RAGS) Volume 1: Human Health Evaluation Manual Parts A and B* (USEPA, 1989; 1991), the American Society for Testing and Materials' (ASTM) *Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites* (ASTM, 1995), and other supplemental state and federal guidance documents referenced throughout the text. The risk evaluation included the following steps: identification of chemicals of potential concern (COPCs), toxicity assessment, exposure assessment, development of SSTLs, and comparison of Site analytical to the calculated SSTLs.

4.3 IDENTIFICATION OF COPCS

COPCs include those site-related chemicals that have the potential to impact human health and the environment. COPCs are identified through the review of analytical data collected from relevant media at a site. The primary medium of concern for this evaluation is off-site groundwater; therefore, the list of COPCs reflects the analytical results from off-site groundwater investigations conducted to date. Since the chemicals detected at the Site are VOCs, there is the potential for chemicals in groundwater to impact indoor air. Therefore, indoor air was also considered a medium of concern.

Table 3 summarizes the chemicals detected during each of the two off-site groundwater investigations, the maximum detected concentration for each chemical, and the sample location and depth interval for each maximum concentration. Since certain exposure pathways (i.e., vapor migration) are only affected by shallow groundwater, the maximum shallow concentration was also identified for each chemical. COPCs were identified as all chemicals detected in one or more groundwater samples from either off-site

investigation. As shown on Table 3, the COPCs addressed in this risk evaluation are cis-1,2-DCE; TCE; naphthalene. Since PCE was not detected in either investigation, it was not included in the risk evaluation.

4.4 TOXICITY ASSESSMENT

SSTLs were developed in consideration of both cancer and noncancer health effects. Toxicity information for each COPC was obtained primarily from USEPA's *Integrated Risk Information System* (IRIS) database (USEPA, 2004). In accordance with USEPA's December 5, 2003 memorandum titled *Human Health Toxicity Values in Superfund Risk Assessments*, the USEPA Region 9 *Preliminary Remediation Goals* table (USEPA, 2002) was used as a source of provisional toxicity values if data were not available in IRIS.

The noncancer and cancer toxicity values used in this evaluation are included on Tables 4 and 5, respectively. For carcinogens, USEPA provides both a toxicity value and a weight-of-evidence classification. The weight-of-evidence classification provides a means of identifying the relative strength of the toxicological database. The weight-of-evidence classifications for carcinogens as described in Guidelines for Carcinogenic Risk Assessment (Federal Register, 1986) are provided on Table 5, and the classification scheme is defined as: A – known human carcinogen; B – probable human carcinogen; C – possible human carcinogen; and D – not classifiable with regard to human carcinogenicity.

In 1996, USEPA proposed revised guidelines for evaluating research evidence for carcinogens, including a more descriptive classification scheme. Since that time, a very limited number of IRIS files have been updated to incorporate the revised classification scheme; therefore, the old scheme was used for this evaluation. It should be noted, however, that the IRIS file for naphthalene is among the few that have been updated to include the revised classification. Using the revised classification guidelines, the human carcinogenicity potential for naphthalene "cannot be determined at this time based on human and animal data."

The potential carcinogenicity of TCE is currently under debate within various federal agencies, including the USEPA and the Department of Defense. USEPA recently published a recommendation that cancer risk be calculated for human populations potentially exposed to TCE; however, this was subsequently placed on hold while additional evaluation of the toxicological data is conducted. Conflicting evaluations of the potential carcinogenicity of TCE have been presented, resulting from varying interpretations of the toxicological data. Given the ongoing debate regarding the appropriateness of USEPA's current provisional toxicity values for TCE, many state agencies and some USEPA regional offices have set forth

a policy wherein risk from TCE is to be evaluated using either the older withdrawn toxicity values or the cancer-based toxicity values set forth by the California Office of Environmental Health Hazard Assessment (OEHHA) (OEHHA, 2004). For this evaluation, the noncancer effects of TCE were evaluated using the older withdrawn noncancer value, and the potential cancer effects were evaluated using the OEHHA value.

4.5 EXPOSURE ASSESSMENT

In the exposure assessment portion of the risk evaluation, potentially exposed populations and potentially completed pathways of exposure are identified. Potentially exposed populations include those persons whose locations and activities create an opportunity for contact with chemicals of possible health concern. The exposure assessment considers possible future land and water uses in order to identify these populations and pathways. Only complete pathways (i.e., human receptors in contact with contaminated media) may pose a possible human health risk.

4.5.1 Current and Future Land and Water Use

The Hardesty Federal Center is located in urban Kansas City, Missouri. The Site is currently inactive and is surrounded by both commercial and residential properties. The off-site investigations extended into both residential and commercial areas near the Site. Zoning for the Site and surrounding areas currently allows for mixed use development.

Groundwater at the Site and in the surrounding area is not currently used as a potable water source. Drinking water is publicly supplied to the area by the City of Kansas City, and is obtained from large municipal well fields located in the Missouri River alluvium. These water sources rely on deep wells that access the coarse grain alluvial deposits at the base of the aquifer (100 feet or more in depth). Millions of dollars in infrastructure have been used to develop these well fields and associated water treatment systems. Additional future water supplies would come from the expansion of existing well fields in close proximity to existing water treatment plants. Given the low yield of the aquifer and the presence of a public water supply system, it is unlikely that groundwater would be used as a drinking water source in the future.

4.5.2 Potentially Exposed Populations and Pathways

Based on the identified current and future land uses, the potentially exposed populations at the Site could include both residential and commercial/industrial populations. Residential populations include both adult and child residents, and commercial/industrial populations include indoor and outdoor commercial workers and short-term excavation (utility and/or construction) workers. Given the broad range of

potentially exposed populations, the following paragraphs will describe the population(s) selected for evaluation and associated rationale for selection.

The medium of concern at the Site is groundwater, which is located approximately at depths ranging from 12 to 22 feet bgs in on-site monitoring wells, with groundwater elevation measurements indicating that groundwater gets deeper toward the east in the direction of the off-site investigation. These measurements indicated that groundwater is unlikely to be encountered during either utility or construction excavation; therefore, short-term utility and/or construction excavation workers are not included in this evaluation.

VOCs in groundwater at these depths could potentially migrate in the vapor phase through cracks in building foundations and be present in indoor air. Similarly, VOCs could potentially migrate to the ground surface and be released into outdoor air; however, wind dispersion likely reduces vapor concentrations to levels well below those likely to accumulate in indoor air. Given that exposure to indoor air represents a more conservative scenario, outdoor workers are not included as a separate population in this evaluation. Rather, it is assumed that SSTLs that are protective of indoor workers would also be protective of outdoor workers.

Adult and child residents spend time both indoors as well as outdoors. However, data compiled by USEPA in Exposure Factors Handbook (USEPA, 1997) indicate that both adults and children spend the majority of their time indoors. For this reason, residents were conservatively assumed to represent an indoor population group. Both residents and indoor workers are considered indoor population with the potential for similar types of exposures. Since the residential scenario incorporates longer timeframes and addresses children, a residential evaluation is more conservative than a worker evaluation. It was therefore assumed that SSTLs based on residents would be adequately protective of workers, subsequently separate SSTLS were not developed for indoor workers.

Based on the above considerations, indoor residents represent the potentially exposed population to be considered in the risk evaluation. Since groundwater is not a current or potential future drinking water source, direct contact and/or ingestion of water were not considered potentially completed exposure pathways. The exposure pathway to be evaluated is inhalation of indoor air.

4.6 DEVELOPMENT OF SSTLS

SSTLs are medium-specific remediation goals that are calculated according to standard human health risk assessment methodology and site-specific physical and exposure information. Tables 4 through 10 show the stepwise series of equations and associated variables that were used to calculate the SSTLs.

Allowable chemical concentrations for indoor residents were calculated separately for non-cancer and cancer health effects. For each chemical, the noncancer- and cancer-based allowable concentrations were compared, and the more protective value was selected as the SSTL. The equations for allowable chemical concentrations combine toxicity data with site-specific exposure assumptions and target noncancer and cancer risk levels. The noncancer and cancer SSTL equations are provided on Tables 4 and 5, along with the toxicity values and exposure variables used in the calculations. In general, the exposure variables represent conservative default values obtained from USEPA guidance. If default values were not available, the proposed exposure variables represent best professional judgement about site activities. As put forth in both MDNR's *CALM and Missouri Risk-Based Corrective Action (MRBCA) Process for Petroleum Storage Tanks* (MDNR, 2004), the target cancer risk level used in the SSTL calculations was one in 100,000 (1×10^{-5} or $1E-05$) and the target non-cancer hazard index was one.

Under USEPA guidance, it is assumed that residents could be exposure to site-related constituents for a continuous 30-year time period. Within that 30-year timeframe, six years represent childhood (from infancy to six years of age) and the remaining 24 represent adulthood. To account for the different exposure variables associated with different age ranges, the cancer SSTLs were calculated using an age-adjusted intake factor that accounts for both childhood and adulthood exposures. The methodology allows the exposure to be addressed as a continuous 30-year block of time, which is more conservative than addressing either the childhood or adulthood exposures individually. Mathematically, the child population represents the most conservative scenario in noncancer evaluations; therefore, the noncancer SSTLs are based on a child resident rather than an adult or age-adjusted scenario.

Although groundwater is a medium of concern at the Site, indoor air is the contact medium. To calculate SSTLs for groundwater based on exposure to indoor air, chemical-specific volatilization factors (VFs) were incorporated into the SSTL equations. The equations that were used to calculate the VFs from groundwater to indoor air were obtained from *ASTM's Standard Guide for Risk-Based Corrective Action at Petroleum Release Sites* (ASTM, 1995) and are based on the indoor vapor model developed by Johnson and Ettinger (1991). The VF equations are simplified versions of the equations used in USEPA's on-line spreadsheets and generally can be expected to yield similar, although potentially slightly more conservative, results.

The equations and variables for calculating the chemical-specific VFs are provided on Tables 6 through 10. The VF calculation accounts for the physical site conditions and chemical properties that influence transport. The variable values used to represent physical site conditions were obtained through geotechnical analysis of a vadose zone sample from Boring BH-1, the results of which are provided as

Appendix D and reiterated on Tables 6 through 10, as needed. Default values, as provided on Tables 6 through 10, were used if site-specific information was not available for a given variable. The chemical properties used in the VF equation include Henry's Law constant, diffusion coefficient in air, and diffusion coefficient in water. Data for chemical properties were obtained from published sources (USEPA, 1996).

After calculating the noncancer and cancer allowable concentrations for each chemical, the final SSTL was selected. Where both noncancer and cancer health effects are evaluated for a single chemical, the final SSTL represents the more protective of the two allowable concentrations. Table 11 represents the comparison of values and selection of final SSTLs. For TCE, the only chemical that was evaluated as a carcinogen, the cancer-based allowable concentration was selected as the final SSTL.

4.7 RESULTS OF RISK EVALUATION

To evaluate the potential risks associated with exposure to chemical concentrations in groundwater, the maximum detected concentrations in groundwater were compared to the final SSTLs. Chemical vapors migrate from the water surface; therefore, only shallow groundwater is relevant to the vapor migration pathway. However, both shallow and deep samples were not collected from each boring during the 2003 investigation, so it was difficult to determine which samples should be included in the shallow data set. To account for this discrepancy, both the maximum detected concentration from any depth interval and the maximum concentration from the shallow depth interval (the approximate top 15 – 20 feet of the water table assuming a groundwater depth of 10 – 15 feet below ground surface) were compared to the calculated SSTLs. The comparison of chemical concentrations in groundwater to SSTLs is shown on Table 12.

Both the overall maximum and shallow maximum concentrations were well below the calculated SSTL for each chemical, indicating that exposure to site-related constituents does not pose appreciable risk to human health.

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5.0 INTERPRETATIONS AND CONCLUSIONS

Based on data gathered during the off-site groundwater investigation, it appears that an isolated area of TCE contamination exists within groundwater northeast of the Site. TCE concentrations were identified above MDNR CALM GTARC action levels within the deep groundwater sample interval at SP-4 and the shallow groundwater sample interval at SP-5. The migration of TCE contamination to the northeast of the site appears to be limited based on surrounding groundwater sample results, which indicated no detections of TCE. The presence of TCE in this area is consistent with the previous off-site groundwater investigation conducted by Terracon in 2003 (Terracon, 2003b) which also identified TCE contamination migrating northeast from the Site. The additional data collected during this investigation was successful in determining the extent of TCE migration to the northeast of the Site.

Groundwater samples collected to the east of the Site did not identify any TCE contamination. Considering the absence of TCE contamination along with the limited occurrence of groundwater and shallow bedrock elevations identified in this area, it appears that contaminant migration is not occurring east of the Site.

An off-site risk evaluation was conducted to assess the potential for adverse health effects to occur as a result of exposure to Site-related chemicals. Residential SSTLs were calculated and compared to maximum detected off-site concentrations for each chemical. Off-site data from both the current and the 2003 investigations were included in the evaluation. Both the shallow maximum and overall maximum concentrations were well below the calculated SSTLs, indicating that exposure to off-site concentrations of site-related constituents in groundwater does not pose appreciable risk of adverse health effects.

Soil gas samples were collected in the northeast corner of the Site to evaluate a potential secondary source of contamination. Each soil gas sample was non detect suggesting that no additional source material exists in that area.

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6.0 OFF-SITE REMEDIATION EVALUATION

According to the Risk Evaluation provided in Section 4.0 of this report, off-site contaminant levels identified within groundwater are unlikely to present a health hazard to local residents; therefore, off-site remediation is not required.

* * * * *

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TABLES

Table 1
Groundwater Results - Field Analysis
May 2004
Hardesty Federal Center

Sample Point:		MDNR	SP-1 / GW-1	SP-1 / GW-2	SP-1 / GW-2D	SP-4 / GW-1	SP-4 / GW-2	SP-5 / GW-1	SP-5 / GW-1D
Date Sampled:		CALM	5/11/2004	5/11/2004	5/11/2004	5/10/2004	5/10/2004	5/10/2004	5/10/2004
Sample Depth From:		GTARC	23	44	44	24	44	23	23
Sample Depth To:		Level	27	48	48	28	48	27	27
Volatiles	UNITS								
cis-1,2-Dichloroethene (cis-1,2-DCE)	ug/L	70	1.6 J	ND	ND	ND	ND	ND	ND
Trichloroethene (TCE)	ug/L	5	ND	ND	ND	ND	34.7	5.6	6.5
Tetrachloroethylene (PCE)	ug/L	5	ND	ND	ND	ND	ND	ND	ND

Sample Point:		MDNR	SP-6 / GW-1	SP-7 / GW-1	SP-7 / GW-2	SP-9 / GW-1	SP-10 / GW-1	SP-10 / GW-2	SP-16 / GW-2
Date Sampled:		CALM	5/10/2004	5/11/2004	5/11/2004	5/12/2004	5/11/2004	5/11/2004	5/10/2004
Sample Depth From:		GTARC	24	25	53	0	26	42	56
Sample Depth To:		Level	28	29	57	24	30	46	60
Volatiles	UNITS								
cis-1,2-Dichloroethene (cis-1,2-DCE)	ug/L	70	ND	ND	ND	ND	ND	ND	ND
Trichloroethene (TCE)	ug/L	5	ND	ND	ND	ND	ND	ND	ND
Tetrachloroethylene (PCE)	ug/L	5	ND	ND	ND	ND	ND	ND	ND

NOTES: SP-8 sample collected for laboratory analysis only.
 SP-9 sample collected from open air borehole.
 Sample locations SP-2, SP-3, SP-11, SP-12, SP-13, SP-14, and SP-15 were dry.

LEGEND: B- Detected in the associated laboratory method blank
 R- Qualified as unusable in the QC evaluation
 NA- Not analyzed

F- Detected in the associated equipment rinsate blank
 T- Detected in associated trip blank
 ND- Not Detected

J- Qualified as estimated by the laboratory
 IJ- Qualified as undetected by the laboratory
 dil - Sample diluted prior to analysis

J*- Qualified as estimated in the QC evaluation
 U*- Qualified as undetected in the QC evaluation

Table 2
Groundwater Results - Laboratory Analysis
May 2004
Hardesty Federal Center

Sample Point:		MDNR	SP-5 / GW-1	SP-7 / GW-2	SP-9 / GW-1	SP-8 / GW-1
Date Sampled:		CALM	5/10/2004	5/11/2004	5/12/2004	5/13/2004
Sample Depth From:		GTARC	23	53	0	0
Sample Depth To:		Level	27	57	24	34
Volatiles	UNITS					
cis-1,2-Dichloroethene (cis-1,2-DCE)	ug/L	70	ND	ND	ND	ND
Trichloroethene (TCE)	ug/L	5	6.5	ND	ND	ND
Tetrachloroethylene (PCE)	ug/L	5	ND	ND	ND	ND

NOTES: SP-8 sample collected for laboratory analysis only.
SP-9 sample collected from open air borehole.

LEGEND: B- Detected in the associated laboratory method blank
R- Qualified as unusable in the QC evaluation
NA- Not analyzed

F- Detected in the associated equipment rinse blank
T- Detected in associated trip blank
ND- Not Detected

J- Qualified as estimated by the laboratory
U- Qualified as undetected by the laboratory
dil - Sample diluted prior to analysis

J*- Qualified as estimated in the QC evaluation
U*- Qualified as undetected in the QC evaluation

Table 3
Identification of Chemicals of Potential Concern
Hardesty Federal Center

Parameter	Number of Detects/ Number of Samples	Maximum Detected Concentration (ug/L)	Location and Depth of Maximum Concentration	Maximum Shallow Concentration ¹ (ug/L)	Location and Depth of Maximum Shallow Concentration	Included as COPC?
2004 Off-Site Investigation ²						
cis-1,2-Dichloroethene	1 / 13	1.6 J	SP-1/GW-1 (23-27 feet)	1.6 J	SP-1/GW-1 (23-27 feet)	yes
Trichloroethene	2 / 13	34.7	SP-4/GW-2 (44-48 feet)	6.5	SP-5/GW-1D (23-27 feet)	yes
Tetrachloroethene	0 / 13	ND	--	ND	--	no
2003 Off-Site Investigation ³						
cis-1,2-Dichloroethene	2 / 6	10.3	B1 (24-28 feet)	10.3	B1 (24-28 feet)	yes
Trichloroethene	4 / 6	229	B2 (37-39 feet)	113	B1 (24-28 feet)	yes
Naphthalene	1 / 6	6.9	B5 (20 feet)	6.9	B5 (20 feet)	yes

Notes:

¹ - Represents maximum concentration in samples collected from approximately the top 15 feet of the aquifer.

² - 2004 information represents off-site mobile laboratory data and includes all chemicals analyzed off-site and those chemicals detected in laboratory confirmation samples.

³ - 2003 information represent off-site laboratory results and includes only positively detected chemicals.

ND - Not Detected

"--" - Information not applicable

Table 4
Allowable Concentrations in Groundwater for Noncancer Effects
Indoor Child Resident Scenario
Hardesty Federal Center

Equation:

$$SSTL_{gw} = \frac{THI \times BW \times AT}{ED \times EF \times ET \times IRa \times VF_{wesp} \times (1/RfDi)}$$

Where:

Cgw = Allowable concentration in groundwater (mg/L)
 THI = Target hazard index (unitless)
 BW = Body weight (kg)
 AT = Averaging time (days)
 ED = Exposure duration (years)
 EF = Exposure frequency (days/year)
 ET = Exposure time (hours/day)
 IRa = Inhalation rate of air (m³/hr)
 VFwesp = Volatilization factor from groundwater to indoor air (L/m³)
 RfDi = Inhalation reference dose (mg/kg-day)

Variables:

Cgw =	Calculated	mg/L
THI =	1.0	unitless (MDNR, 2004)
BW =	15	kg (USEPA, 1989)
AT =	2,100	days (USEPA, 1989)
ED =	6	years (USEPA, 1989)
EF =	350	days/year (USEPA, 1991a)
ET =	24	hours/day (Conservative default assumption)
IRa =	0.27	m ³ /hour (USEPA, 1997) (Represents 15.2 m ³ /day)
VFwesp =	Chemical-specific	L/m ³ (See Table 6)
RfDi =	Chemical-specific	mg/kg-day (USEPA, 2004 unless otherwise noted)

Parameter	VFwesp (L/m ³)	RfDi (mg/kg-day)	Cgw (mg/L)
cis-1,2-Dichloroethene ¹	1.02E-04	1.0E-02	2.28E+02
Trichloroethene ²	2.71E-04	6.0E-03	5.12E+01
Naphthalene	1.08E-05	8.6E-04	1.85E+02

Notes:

- ¹ - Value represents route-to-route extrapolation from oral reference dose (USEPA, 2002).
- ² - Value represents route-to-route extrapolation from withdrawn oral reference dose (USEPA, 2000).

Table 5
Allowable Concentrations in Groundwater for Cancer Effects
Indoor Residential Scenario
Hardesty Federal Center

Equation:

$$C_{gw} = \frac{TR \times AT}{EF \times InhFadj \times VFwesp \times SFi}$$

Where:

C_{gw} = Allowable concentration in groundwater (mg/L)

TR = Target risk level (unitless)

AT = Averaging time (days)

EF = Exposure frequency (days/year)

$InhFadj$ = Age-adjusted inhalation factor $([m^3 \cdot year]/[kg \cdot day])$

Where: $InhFadj = (EDc \times ETc \times IRAc / BWc) + (EDa \times ETa \times IRAa / BWa)$

EDc = Child exposure duration (years)

ETc = Child exposure time (hours/day)

IRAc = Child inhalation rate (m^3 /hour)

BWc = Child body weight (kg)

EDa = Adult exposure duration (years)

ETa = Adult exposure time (hours/day)

IRAa = Adult inhalation rate (m^3 /hour)

BWa = Adult body weight (kg)

$VFwesp$ = Volatilization factor from groundwater to indoor air (L/m^3)

SFi = Inhalation slope factor $1/(mg/kg \cdot day)$

Variables:

C_{gw} =	Calculated	mg/L
TR =	1E-05	unitless (MDNR, 2004)
AT =	25,550	days (USEPA, 1989)
EF =	350	days/year (USEPA, 1991a)
$InhFadj$ =	7.801	$(m^3 \cdot year)/(kg \cdot day)$ (Calculated)
EDc =	6	years (USEPA, 1989)
ETc =	24	hours/day (Conservative default assumption)
IRAc =	0.27	m^3 /hour (USEPA, 1997) (Represents 6.5 m^3 /day)
BWc =	15	kg (USEPA, 1989)
EDa =	24	years (USEPA, 1989)
ETa =	24	hours/day (Conservative default assumption)
IRAa =	0.633	m^3 /hour (USEPA, 1997) (Represents 15.2 m^3 /day)
BWa =	70	kg (USEPA, 1989)
$VFwesp$ =	Chemical-specific	L/m^3 (See Table 6)
SFi =	Chemical-specific	$1/(mg/kg \cdot day)$ (USEPA, 2004 unless otherwise noted)

Parameter	$VFwesp$ (L/m^3)	Weight of Evidence Classification ¹	SFi $1/(mg/kg \cdot day)$	C_{gw} (mg/L)
cis-1,2-Dichloroethene	1.02E-04	D	Not Available	--
Trichloroethene ²	2.71E-04	Not Available	7.00E-03	4.93E+01
Naphthalene	1.08E-05	C	Not Available	--

Notes:

¹ - Weight-of-evidence classifications obtained from USEPA's IRIS database (USEPA, 2004).

² - Value obtained from California Office of Environmental Health Hazard Assessment Toxicity Criteria.

"--" - Not calculated due to lack of available toxicity data.

Table 6
Volatilization Factor from Groundwater to Indoor Air *
Hardesty Federal Center

Equation:

$$VF_{wesp} \left[\frac{L}{m^3} \right] = \frac{H' \left[\frac{D_{ws}^{eff} / L_{GW}}{ER \times L_b} \right]}{1 + \left[\frac{D_{ws}^{eff} / L_{GW}}{ER \times L_b} \right] + \left[\frac{D_{ws}^{eff} / L_{GW}}{(D_{crack}^{eff} / L_{crack}) n} \right]} \times 10^3 \frac{L}{m^3}$$

Where:

- VFwesp = Volatilization factor for groundwater to enclosed-space vapors (L/m³)
H' = Henry's law constant (unitless)
Deffws = Effective diffusion coefficient between groundwater and soil surface (cm²/s)
Lgw = Depth to groundwater (cm), where Lgw = hcap + hv
hcap = Thickness of capillary fringe (cm)
hv = Thickness of vadose zone (cm)
ER = Enclosed-space air exchange rate (s⁻¹)
Lb = Enclosed-space volume/infiltration area ratio (cm)
Deffcrack = Effective diffusion coefficient through foundation cracks (cm²/s)
Lcrack = Enclosed-space foundation or wall thickness (cm)
n = Areal fraction of cracks in foundations/walls (cm²/cm²)

Variables:

VFwesp =	Calculated	
H' =	Chemical-specific	unitless (USEPA, 1996)
Deffws =	Chemical-specific	cm ² /s (See Table 7)
Lgw =	305	cm (Site-specific) (assumed depth of 10 feet)
hcap =	5	cm (ASTM, 1995)
hv =	300	cm (Site-specific)
ER =	0.00014	s ⁻¹ (ASTM, 1995) (assumes 12 air exchanges per day)
Lb =	244	cm (assumes 8-ft room height)
Deffcrack =	Chemical-specific	cm ² /s (See Table 10)
Lcrack =	15	cm (ASTM, 1995) (represents 6-inch floor slab)
n =	0.00056	cm ² /cm ² (Sager, 1997)

Chemical	H' (unitless)	Deffws (cm ² /s)	Deffcrack (cm ² /s)	VFwesp (L/m ³)
cis-1,2-Dichloroethene	1.67E-01	4.66E-04	5.64E-04	1.02E-04
Trichloroethene	4.22E-01	4.39E-04	5.97E-04	2.71E-04
Naphthalene	1.98E-02	4.84E-04	5.04E-04	1.08E-05

*ASTM, 1995

Table 7
Effective Diffusion Coefficient Between Groundwater and Soil Surface*
Hardesty Federal Center

Equation:

$$D_{ws}^{eff} \left[\frac{cm^2}{s} \right] = \frac{(h_{cap} + h_v)}{\left[\frac{h_{cap}}{D_{cap}^{eff}} + \frac{h_v}{D_s^{eff}} \right]}$$

Where:

Deffws = Effective diffusion coefficient between groundwater and soil surface (cm²/s)

hcap = Thickness of capillary fringe (cm)

hv = Thickness of vadose zone (cm)

Deffcap = Effective diffusion coefficient through capillary fringe (cm²/s)

Deffs = Effective diffusion coefficient in soil (cm²/s)

Variables:

Deffws =	Calculated	cm ² /s
hcap =	5	cm (ASTM, 1995)
hv =	300	cm (Site-specific)
Deffcap =	Chemical-specific	cm ² /s (See Table 8)
Deffs =	Chemical-specific	cm ² /s (See Table 9)

Chemical	Deffcap (cm ² /s)	Deffs (cm ² /s)	Deffws (cm ² /s)
cis-1,2-Dichloroethene	4.06E-05	5.64E-04	4.66E-04
Trichloroethene	2.60E-05	5.97E-04	4.39E-04
Naphthalene	1.45E-04	5.04E-04	4.84E-04

*ASTM, 1995

Table 8
Effective Diffusion Coefficient Through Capillary Fringe*
Hardesty Federal Center

Equation:

$$D_{cap}^{eff} \left[\frac{cm^2}{s} \right] = D^i \frac{\Theta_{acap}^{3.33}}{\Theta_T^2} + \left(D^w \times \frac{1}{H'} \times \frac{\Theta_{wcap}^{3.33}}{\Theta_T^2} \right)$$

Where:

Deffcap = Effective diffusion coefficient through capillary fringe (cm²/s)

Di = Diffusion coefficient in air (cm²/s)

Oacap = Volumetric air content in capillary fringe soils (cm³/cm³)

Dw = Diffusion coefficient in water (cm²/s)

Owcap = Volumetric water content in capillary fringe soils (cm³/cm³)

Ot = Total soil porosity (cm³/cm³)

H' = Henry's law constant (unitless)

Variables:

Deffcap =	Calculated	cm ² /s
Di =	Chemical-specific	cm ² /s (USEPA, 1996)
Oacap =	0.059	cm ³ /cm ³ (10 percent of Ot)
Dw =	Chemical-specific	cm ² /s (USEPA, 1996)
Owcap =	0.527	cm ³ /cm ³ (90 percent of Ot)
Ot =	0.586	cm ³ /cm ³ (See Appendix D)
H' =	Chemical-specific	unitless (USEPA, 1996)

Chemical	Di (cm ² /s)	Dw (cm ² /s)	H' (unitless)	Deffcap (cm ² /s)
cis-1,2-Dichloroethene	7.36E-02	1.13E-05	1.67E-01	4.06E-05
Trichloroethene	7.90E-02	9.10E-06	4.22E-01	2.60E-05
Naphthalene	5.90E-02	7.50E-06	1.98E-02	1.45E-04

* ASTM, 1995

Table 9
Effective Diffusion Coefficient in Soil
Hardesty Federal Center

Equation:

$$D_s^{eff} \left[\frac{\text{cm}^2}{\text{s}} \right] = D_i \frac{\Theta_{as}^{3.33}}{\Theta_T^2} + \left(D_w \times \frac{1}{H'} \times \frac{\Theta_{ws}^{3.33}}{\Theta_T^2} \right)$$

Where:

Deffs = Effective diffusion coefficient in soil based on vapor-phase concentration (cm²/s)

Di = Diffusion coefficient in air (cm²/s)

Oas = Volumetric air content in vadose zone soils (cm³/cm³)

Dw = Diffusion coefficient in water (cm²/s)

Ows = Volumetric water content in vadose zone soils (cm³/cm³)

Ot = Total soil porosity (cm³/cm³)

H' = Henry's law constant (unitless)

Variables:

Deffs =	Calculated	cm ² /s
Di =	Chemical-specific	cm ² /s (USEPA, 1996)
Oas =	0.167	cm ³ /cm ³ (calculated as Ot - Ows)
Dw =	Chemical-specific	cm ² /s (USEPA, 1996)
Ows =	0.419	cm ³ /cm ³ (See Appendix D)
Ot =	0.586	cm ³ /cm ³ (See Appendix D)
H' =	Chemical-specific	unitless (USEPA, 1996)

Chemical	Di (cm ² /s)	Dw (cm ² /s)	H' (unitless)	Deffs (cm ² /s)
cis-1,2-Dichloroethene	7.36E-02	1.13E-05	1.67E-01	5.64E-04
Trichloroethene	7.90E-02	9.10E-06	4.22E-01	5.97E-04
Naphthalene	5.90E-02	7.50E-06	1.98E-02	5.04E-04

*ASTM, 1995

Table 10
Effective Diffusion Coefficient Through Foundation Cracks*
Hardesty Federal Center

Equation:

$$D_{\text{crack}}^{\text{eff}} \left[\frac{\text{cm}^2}{\text{s}} \right] = D^i \frac{\Theta_{\text{acrack}}^{3.33}}{\Theta_T^2} + \left(D^w \times \frac{1}{H'} \times \frac{\Theta_{\text{wcrack}}^{3.33}}{\Theta_T^2} \right)$$

Where:

Deffcrack = Effective diffusion coefficient through foundation cracks (cm²/s)

Di = Diffusion coefficient in air (cm²/s)

Oacrack = Volumetric air content in foundation crack (cm³/cm³)

Dw = Diffusion coefficient in water (cm²/s)

Owcrack = Volumetric water content in foundation crack (cm³/cm³)

Ot = Total soil porosity (cm³/cm³)

H' = Henry's law constant (unitless)

Variable Values:

Deffcrack =	Calculated	cm ² /s
Di =	Chemical-specific	cm ² /s (USEPA, 1996)
Oacrack =	0.167	cm ³ /cm ³ (calculated as Ot - Owcrack)
Dw =	Chemical-specific	cm ² /s (USEPA, 1996)
Owcrack =	0.419	cm ³ /cm ³ (assumed equal to vadose zone soils)
Ot =	0.586	cm ³ /cm ³ (See Appendix D)
H' =	Chemical-specific	unitless (USEPA, 1996)

Chemical	Di (cm ² /s)	Dw (cm ² /s)	H' (unitless)	Deffcrack (cm ² /s)
cis-1,2-Dichloroethene	7.36E-02	1.13E-05	1.67E-01	5.64E-04
Trichloroethene	7.90E-02	9.10E-06	4.22E-01	5.97E-04
Naphthalene	5.90E-02	7.50E-06	1.98E-02	5.04E-04

*ASTM, 1995

Table 11
Selection of Site-Specific Target Levels in Groundwater
Residential Indoor Scenario
Hardesty Federal Center

Parameter	Cgw		SSTLgw ¹ (mg/L)
	Cancer (mg/L)	Noncancer (mg/L)	
cis-1,2-Dichloroethene	--	2.3E+02	2.28E+02
Trichloroethene	4.93E+01	5.1E+01	4.93E+01
Naphthalene	--	1.8E+02	1.85E+02

Note:

- ¹ - SSTLgw (site-specific target level in groundwater) represents the lower of the cancer or noncancer Cgw (allowable concentration in groundwater) values.

Cancer Cgw values obtained from Table 5.

Noncancer Cgw values obtained from Table 4.

Table 12
Comparison of Chemical Concentrations in Groundwater
to Site-Specific Target Levels
Hardesty Federal Center

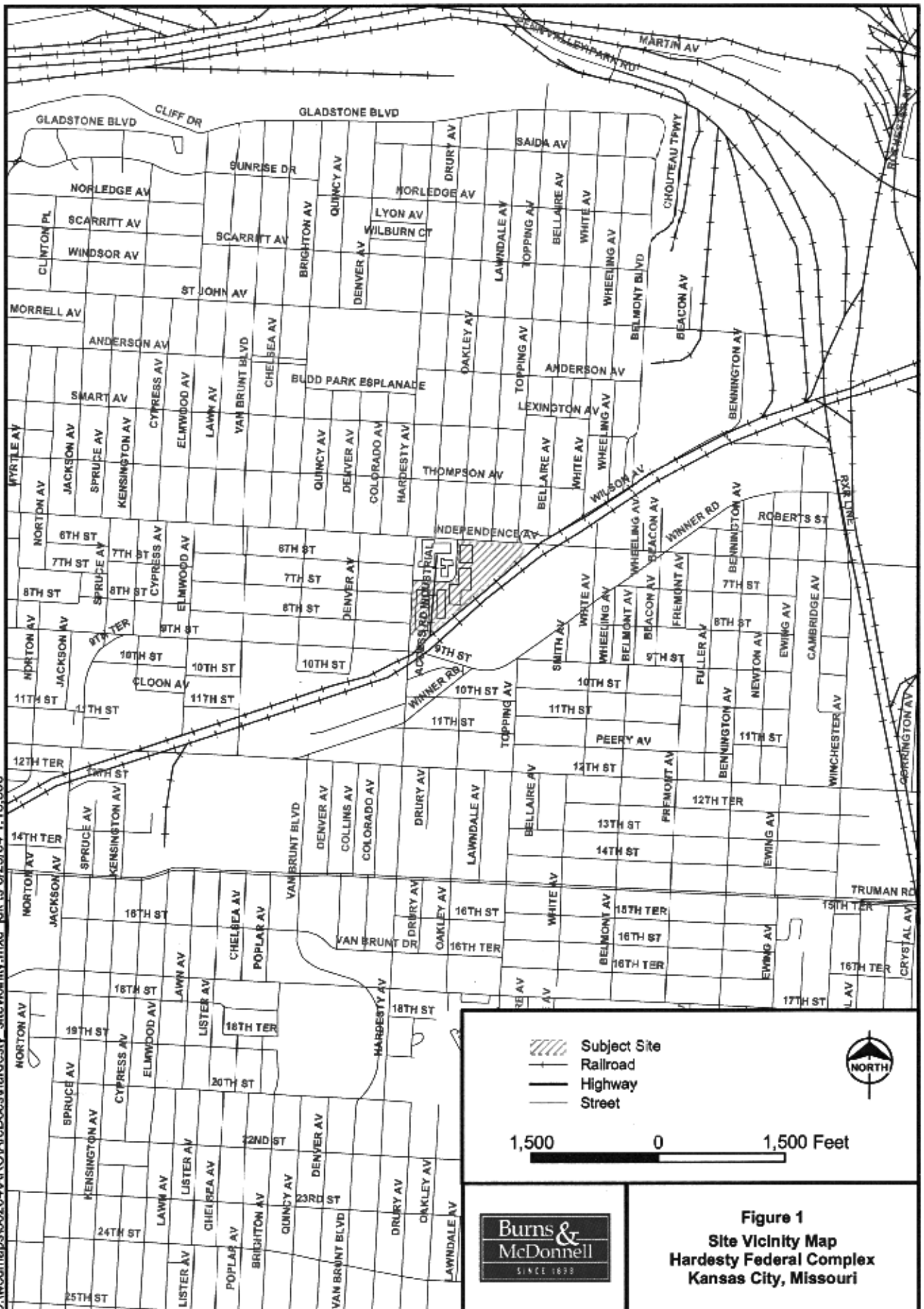
Chemical	Site-Specific Target Level in Groundwater (mg/L)	Maximum Detected Shallow Concentration (mg/L)	Maximum Detected Concentration (mg/L)
cis-1,2-Dichloroethene	228	0.0016 J	0.0016 J
Trichloroethene	49.3	0.113	0.229
Naphthalene	185	0.0069	0.0069

Note:

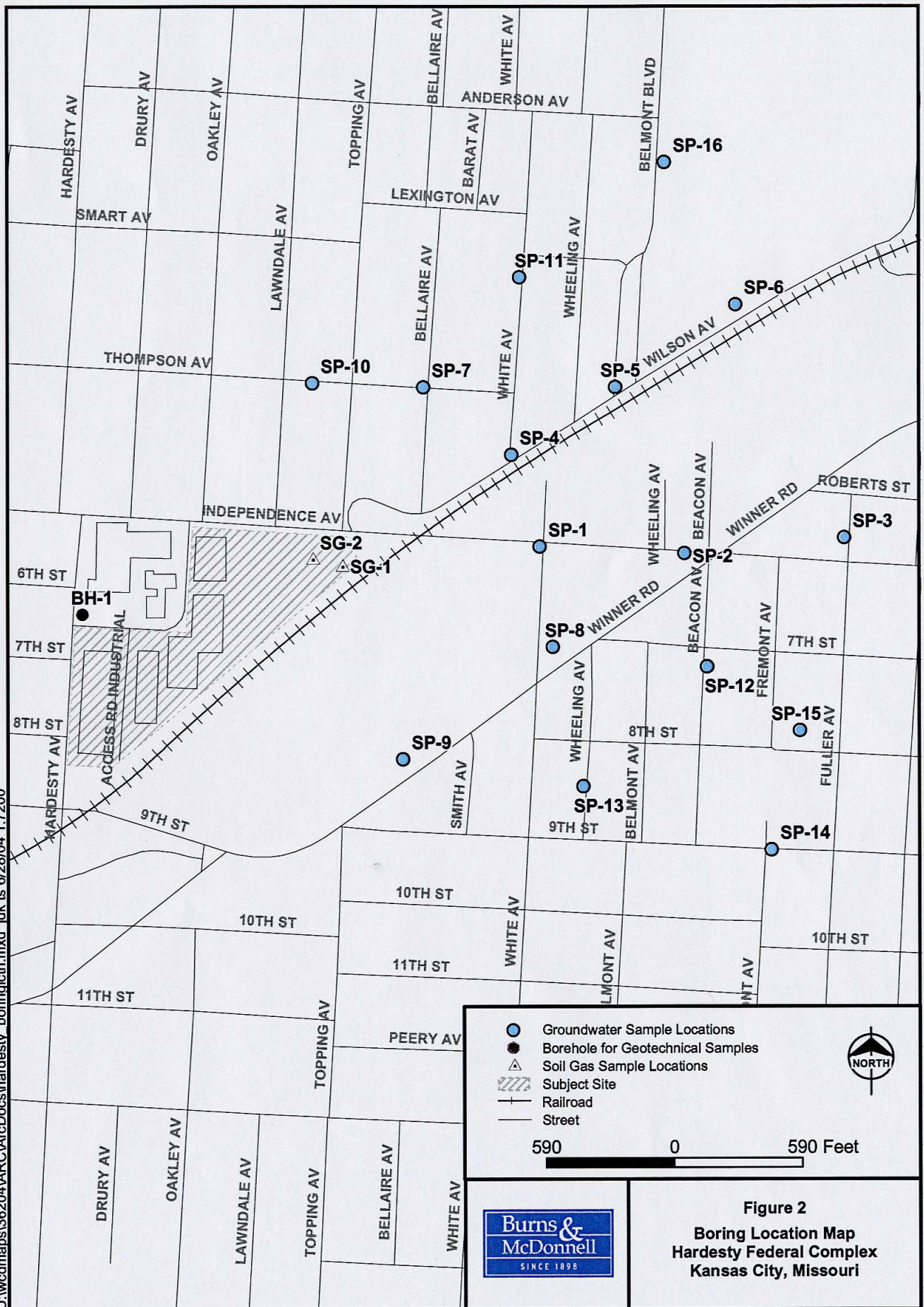
Maximum concentration values represent the highest concentration from both investigations.

FIGURES

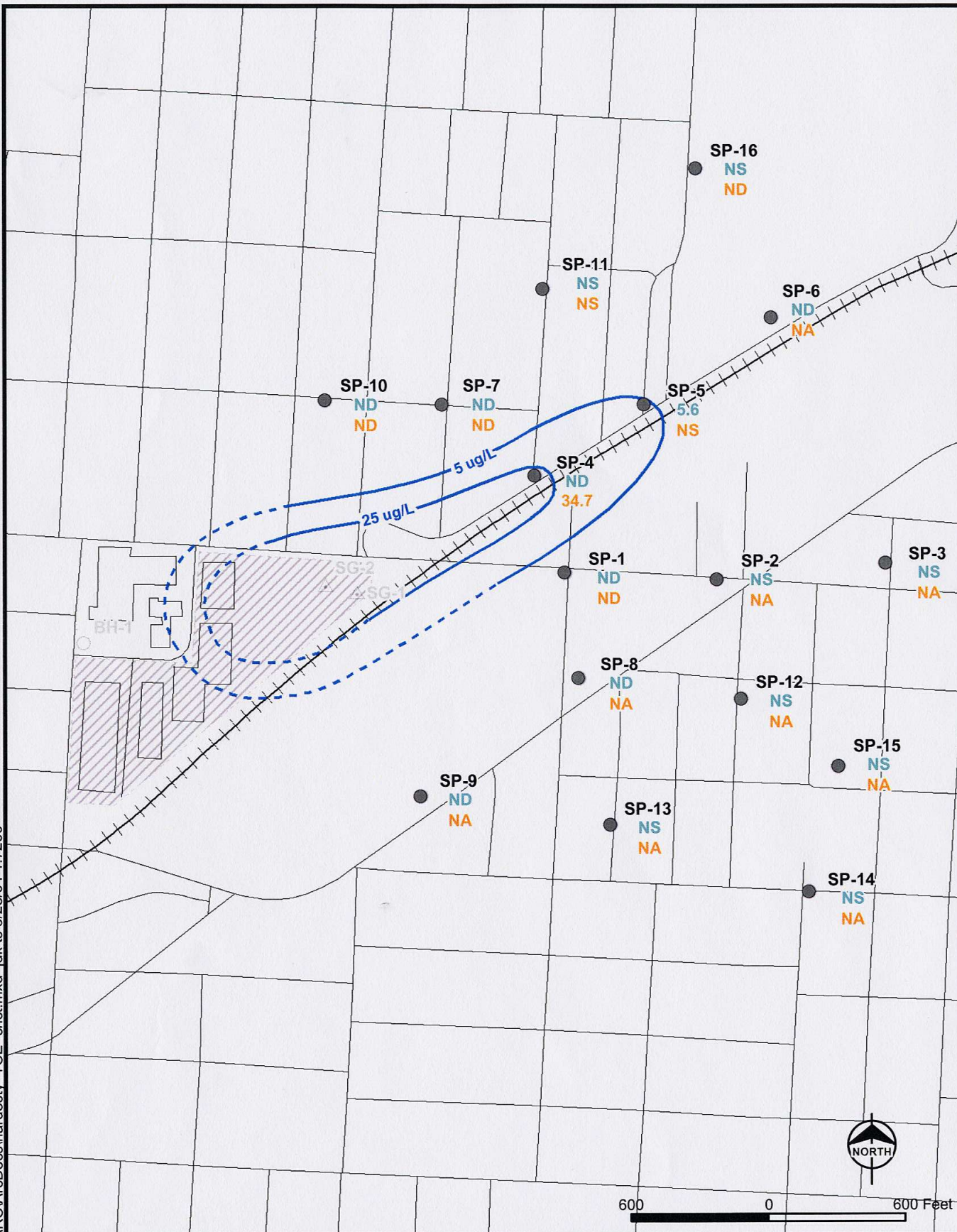
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U:\wcdmaps\36204\ARC\ArcDocs\hardesty boring\lctn.mxd idk ts 6/28/04 1:7200



U:\wcdmaps\36204\ARC\ArcDocs\hardesty TCE cncr.mxd jdk ts 6/28/04 1:7200



Note: On-Site concentrations based on historical monitoring well data.



Figure 3
Trichloroethene (TCE)
Isoconcentration Map
Hardesty Federal Complex
Kansas City, Missouri

APPENDIX A
INVESTIGATION WORK PLAN



April 19, 2004

Mr. Dave L. Hartshorn (6PEF-S)
General Services Administration
1500 East Bannister Road
Kansas City, Missouri 64131

Work Plan for Off-Site Groundwater Investigation
Hardesty Federal Center
Project No. 36204

Dear Mr. Hartshorn:

Burns & McDonnell (BMCD) is submitting this Work Plan to address the off-site groundwater investigation to be conducted at the Hardesty Federal Center in Kansas City, Missouri (Site).

PURPOSE

The purpose of the investigation is to further evaluate the potential lateral and vertical extent of chlorinated volatile organic compounds (VOCs) in off-site groundwater. Previous investigations conducted by GSA at the Hardesty Federal Center have identified the presence of groundwater contamination in areas both beneath the site and off-site to the east-northeast. The investigation will focus on identifying the extent of potential off-site contamination and evaluate any potential impacts to the surrounding environment.

SCOPE OF WORK

Field investigation activities will consist of conducting shallow and deep groundwater sampling using direct-push techniques for field analysis of chlorinated solvents. Samples will be analyzed onsite by Environmental Priority Service (EPS) of Salina, Kansas and off-site for confirmation analysis by Analytical Management Laboratories, Inc. (AML) of Lenexa, Kansas. Based on a review of data collected from previous investigations, the direct-push groundwater sampling is proposed at locations shown on the attached Figure 1. In addition to direct-push groundwater samples, two soil gas samples will be collected at the northeast corner of the Site and geotechnical samples will be collected from one of the off-site sample locations. All sample locations should be considered preliminary, and may be adjusted depending on specific field conditions.

MDNR will be notified five days prior to conducting the field sampling activities.

A health and safety plan has been prepared by BMCD for the activities associated with the investigation and is provided as an attachment to this Work Plan.

FIELD SAMPLING AND ANALYSIS PROCEDURES

Utility Clearance, Permits and Traffic Control

Prior to initiation of subsurface activities, utility clearance will be required. Utilities will be



Mr. Dave L. Hartshorn
April 19, 2004
Page 2 of 3

located with the aid of Missouri One-Call, a utility locating service. Subsurface activities will not be conducted within 5 feet of any marked underground utilities. Due to the presence of underground utilities, it may be necessary to offset probe locations.

Excavation and traffic permits will be required from the City of Kansas City, Missouri providing access to conduct the investigation within the right-of-way. Permits will be obtained prior to conducting the investigation and will be maintained onsite during field activities. In addition, proper traffic control (signs and cones) will be established while conducting field activities within the right-of-way.

Sampling Activities

Initially, 16 direct-push borings will be completed to characterize the potential extent of VOC contamination within off-site groundwater. Sample locations are located at approximately 500 feet intervals moving from the site to the northeast and east as indicated on the attached Figure 1. Each direct-push groundwater boring will be discretely sampled from both the shallow and deep zones of the aquifer. The shallow zone samples will be collected within the first 10 feet of groundwater and the deep zone samples will be collected within the last 10 feet of groundwater above probe refusal. If less than 15 feet of groundwater thickness is encountered at a particular sample location, only one sample will be collected. Sample locations will be considered dry if sufficient groundwater is not recovered within 30 minutes. Samples will be analyzed onsite for the VOCs perchloroethene (PCE), trichloroethene (TCE), and cis-1,2-dichloroethene (cis-1,2-DCE) using a field gas chromatograph (GC). Groundwater samples will be retrieved from the target sampling depth by using either a slotted rod or an extendable drop-out screen. New polyethylene tubing and attached clean check valve will be inserted inside the rods and lowered to the screened interval for sample collection. A minimum of eight split samples will be collected (one per every four samples collected) and sent to an off-site laboratory for confirmation analysis using EPA Method 8260B.

Two soil gas samples will be collected to determine the potential presence of a second source at the Site. Locations of the soil gas samples are provided on the attached Figure 1. Each soil gas sample will be collected from two depths, approximately 8-10 feet and 15-17 feet below ground surface, and analyzed onsite for PCE, TCE, and cis-1,2-DCE.

Geotechnical samples will be collected from one of the off-site boring locations to obtain information necessary for the risk evaluation. Geotechnical samples will be sent to an off-site laboratory for analysis of moisture content, total organic carbon, and bulk density.

Following completion of sample collection at direct-push sampling locations, probe holes will be abandoned by filling the hole with either bentonite chips or fine-grained bentonite, and hydrating the bentonite.



Mr. Dave L. Hartshorn
April 19, 2004
Page 3 of 3

All sample locations will be surveyed with GPS and field instruments.

Documentation and Quality Assurance/Quality Control (QA/QC)

Prior to the start of field activities, the field GC will be calibrated using standards from stock solutions of target compounds. At 5 percent of the locations, a field duplicate sample will be collected for field GC analysis. At 5 percent of the groundwater sample locations, a rinsate blank will be collected for field GC analysis. The rinsate sample will be collected following decontamination of the sample screen by pouring deionized water over the sample screen and collecting the rinse water. QA/QC procedures and results will be documented in the report prepared by the direct-push contractor, and evaluated by BMcD personnel.

A trip blank will accompany each cooler shipment to the analytical laboratory.

REPORT PREPARATION

An investigation summary report will be prepared to present the results of the investigation. The report will include the following:

- A final map of sample locations,
- Tables summarizing analytical results.
- Confirmation data evaluation,
- Extent of contamination,
- A risk evaluation, and
- Conclusions derived from the investigation
- Onsite and offsite remediation evaluations

If you have any questions concerning this Work Plan, please contact me at (816) 822-3369 or Tim Stecher at (816) 822-3436.

Sincerely,

Tracy L. Cooley
Project Manager

Attachments

Cc: Christine O'Keefe – MDNR

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APPENDIX B
ENVIRONMENTAL PRIORITY SERVICE ANALYTICAL REPORT

DATE: May 10, 2004
PROJECT: Hardesty Federal Center
PROJ. #: 040510
Analyst: Chris Jensen

Chrom #	Sample ID	Depth	Type	DCE	TCE	PCE	Comments
002z	Method blank	NA	H2O	ND	ND	ND	
003	2 ppb std	NA	H2O	2.1	2.5	2.4	
003a	SP-4	44-48'	H2O	ND	34.7	ND	Probe refusal-48'
003b	SP-4	24-28'	H2O	ND	ND	ND	
003c	Rinsate blank	NA	H2O	ND	ND	ND	
003d	SP-5	23-27'	H2O	ND	5.6	ND	Probe refusal-27'
003e	SP-5	23-27'	H2O	ND	6.5	ND	Duplicate
003f	SP-6	24-28'	H2O	ND	ND	ND	Probe refusal-28'
003g	SP-16	56-60'	H2O	ND	ND	ND	Probe refusal-60' (½ full vial)
003h	25 ppb std	NA	H2O	24.6	22.1	24.3	

Results are given in ug/l (ppb) for groundwater

ND = Not Detected

NA = Not Available/Applicable

Minimum reporting limit of 2 ppb for Cis 1,2 Dichloroethene (DCE), Trichloroethene (TCE), and Tetrachloroethene (PCE) in water

J = Estimated Value Below Calibration Range

DATE: May 11, 2004
PROJECT: Hardesty Federal Center
PROJ. #: 040510
Analyst: Chris Jensen

Chrom #	Sample ID	Depth	Type	DCE	TCE	PCE	Comments
003i	Method blank	NA	H2O	ND	ND	ND	
003j	2 ppb std	NA	H2O	2.0	2.1	1.7	
003k	SP-7	53-57'	H2O	ND	ND	ND	Probe refusal-57'
003l	SP-10	42-46'	H2O	ND	ND	ND	Probe refusal-46'
003m	SP-10	26-30'	H2O	ND	ND	ND	½ vial
003n	SP-7	25-29'	H2O	ND	ND	ND	½ vial
003o	SP-1	44-48'	H2O	ND	ND	ND	Probe refusal-48'
003p	SP-1	26-30'	H2O	1.6J	ND	ND	
003q	SG-1	8-10'	Soil Gas	ND	ND	ND	3 second recovery
003r	SG-1	15-17'	Soil Gas	ND	ND	ND	8 second recovery
003s	SG-2	8-10'	Soil Gas	ND	ND	ND	3 second recovery
003t	SG-2	15-17'	Soil Gas	ND	ND	ND	4 second recovery
003u	SP-1	44-48'	H2O	ND	ND	ND	Duplicate
003v	20 ppb std	NA	H2O	22.8	20.8	19.9	

Results are given in ug/l (ppb) for groundwater

ND = Not Detected

NA = Not Available/Applicable

Minimum reporting limit of 2 ppb for Cis 1,2 Dichloroethene (DCE), Trichloroethene (TCE), and Tetrachloroethene (PCE) in water

J = Estimated Value Below Calibration Range

DATE: May 12, 2004
PROJECT: Hardesty Federal Center
PROJ. #: 040510
Analyst: Chris Jensen

Chrom #	Sample ID	Depth	Type	DCE	TCE	PCE	Comments
003w	Method blank	NA	H2O	ND	ND	ND	
003x	12 ppb std	NA	H2O	13.7	11.5	10.7	
003y	SP-9	24'	H2O	ND	ND	ND	Refusal-24'
003z	30 ppb std	NA	H2O	25.4	33.3	37.2	
NA	SP-3	NA	NA	ND NA	ND NA	ND NA	Refusal-32', Dry
NA	SP-8	NA	NA	ND NA	ND NA	ND NA	Refusal-34', Dry
NA	SP-11	NA	NA	ND NA	ND NA	ND NA	Refusal-60', Dry
NA	SP-12	NA	NA	ND NA	ND NA	ND NA	Refusal-10', Dry
NA	SP-13	NA	NA	ND NA	ND NA	ND NA	Refusal-18', Dry
NA	SP-14	NA	NA	ND NA	ND NA	ND NA	Refusal-24', Dry
NA	SP-15	NA	NA	ND NA	ND NA	ND NA	Refusal-15', Dry
NA	SP-16	NA	NA	ND NA	ND NA	ND NA	Refusal-60', Dry

Results are given in ug/l (ppb) for groundwater

ND = Not Detected

NA = Not Available/Applicable

Minimum reporting limit of 2 ppb for Cis 1,2 Dichloroethene (DCE), Trichloroethene (TCE), and Tetrachloroethene (PCE) in water

J = Estimated Value Below Calibration Range

APPENDIX C
ANALYTICAL MANAGEMENT LABORATORY ANALYTICAL REPORT



Analytical Management Laboratories, Inc.
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15130 South Keeler, Olathe, Kansas 66062
Phone: (913) 829-0101 • Fax: (913) 829-1181

Certificate of Analysis

May 25, 2004

Tim Stecher
Burns & McDonnell
9400 Ward Parkway
Kansas City, MO 64114
Phone: 333-9400
Fax: 822-3494

Client Project #: 36204/GSA Hardesty Federal Building

Laboratory Work Order #: 5067

Dear Mr. Simmons:

Included are the analytical results for the samples received on May 12, 2004. All analyses were prepared and analyzed within analytical holding time.

Data qualifiers are as follows:

- ND = Not detected at or above the reporting limit.
- B = Some level of the compound was present in the method blank.
- J = Compound results are an estimated concentration.
- E = Compound present in levels greater than the instrument calibration range.

If you have any questions regarding this report, please call me at (913) 829-0101.

Kendall L. Lindquist, MBA
Operations Manager



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Tim Stecher

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Certificate of Analysis

Client Project #: 36204/GSA Hardesty Federal Building

Laboratory Work Order #: 5067

Client Sample ID:	Trip Blank	Date Collected:	05/10/04
Lab Sample ID:	506701	Date Received:	05/12/04

Volatiles	Date Analyzed:	05/15/04	Analyst:	KLL	Method:	8260B
Analyte	Results	Units	Reporting Limit			
Dichlorodifluoromethane	ND	µg/L	2			
Chloromethane	ND	µg/L	2			
Vinyl Chloride	ND	µg/L	2			
Bromomethane	ND	µg/L	2			
Chloroethane	ND	µg/L	2			
Acetone	ND	µg/L	2			
1,1-Dichloroethene	ND	µg/L	2			
Methylene Chloride	ND	µg/L	2			
Carbon Disulfide	ND	µg/L	2			
Methyl Tert Butyl Ether (MTBE)	ND	µg/L	2			
trans-1,2-Dichloroethene	ND	µg/L	2			
1,1-Dichloroethane	ND	µg/L	2			
2-Butanone (MEK)	ND	µg/L	2			
cis-1,2-Dichloroethene	ND	µg/L	2			
2,2-Dichloropropane	ND	µg/L	2			
Bromochloromethane	ND	µg/L	2			
Chloroform	ND	µg/L	2			
1,1,1-Trichloroethane	ND	µg/L	2			
1,1-Dichloropropene	ND	µg/L	2			
Carbon Tetrachloride	ND	µg/L	2			
1,2-Dichloroethane	ND	µg/L	2			
Benzene	ND	µg/L	2			
Trichloroethene	ND	µg/L	2			
1,2-Dichloropropane	ND	µg/L	2			
Dibromomethane	ND	µg/L	2			
Bromodichloromethane	ND	µg/L	2			
2-Chloroethyl vinyl ether	ND	µg/L	2			
cis-1,3-Dichloropropene	ND	µg/L	2			
4-Methyl-2-pentanone (MIBK)	ND	µg/L	2			
Toluene	ND	µg/L	2			
trans-1,3-Dichloropropene	ND	µg/L	2			
1,1,2-Trichloroethane	ND	µg/L	2			
1,3-Dichloropropane	ND	µg/L	2			
Tetrachloroethene	ND	µg/L	2			
2-Hexanone	ND	µg/L	2			
Dibromochloromethane	ND	µg/L	2			
1,2-Dibromoethane	ND	µg/L	2			
Chlorobenzene	ND	µg/L	2			



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Certificate of Analysis

Client Project #: 36204/GSA Hardesty Federal Building

Laboratory Work Order #: 5067

Client Sample ID: Trip Blank

Lab Sample ID: 506701

Volatiles	Date Analyzed:	05/15/04	Analyst:	KLL	Method:	8260B
<u>Analyte</u>	<u>Results</u>	<u>Units</u>	<u>Reporting Limit</u>			
1,1,1,2-Tetrachloroethane	ND	µg/L	2			
Ethyl Benzene	ND	µg/L	2			
m/p Xylene	ND	µg/L	2			
o Xylene	ND	µg/L	2			
Styrene	ND	µg/L	2			
Bromoform	ND	µg/L	2			
Isopropyl benzene	ND	µg/L	2			
1,1,2,2-tetrachloroethane	ND	µg/L	2			
Bromobenzene	ND	µg/L	2			
1,2,3-Trichloropropane	ND	µg/L	2			
n-Propyl benzene	ND	µg/L	2			
2-Chlorotoluene	ND	µg/L	2			
1,3,5-Trimethyl benzene	ND	µg/L	2			
4-chlorotoluene	ND	µg/L	2			
tert Butyl benzene	ND	µg/L	2			
1,2,4-trimethyl benzene	ND	µg/L	2			
sec Butyl benzene	ND	µg/L	2			
1,3-Dichlorobenzene	ND	µg/L	2			
p-isopropyl toluene	ND	µg/L	2			
1,4-Dichlorobenzene	ND	µg/L	2			
n-Butyl benzene	ND	µg/L	2			
1,2-Dichlorobenzene	ND	µg/L	2			
1,2-Dibromo-3-chloropropane	ND	µg/L	2			
1,2,4-Trichlorobenzene	ND	µg/L	2			
Hexachlorobutadiene	ND	µg/L	2			
Naphthalene	ND	µg/L	2			
1,2,3-Trichlorobenzene	ND	µg/L	2			
Dibromofluoromethane (surrogate)	94	%				
1,2-Dichloroethane-d4 (surrogate)	84	%				
Toluene-d8 (surrogate)	100	%				
4-Bromofluorobenzene (surrogate)	85	%				



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Certificate of Analysis

Client Project #: 36204/GSA Hardesty Federal Building

Laboratory Work Order #: 5067

Client Sample ID: GSA SP-5 GW-1

Date Collected:

05/10/04

Lab Sample ID: 506702

Date Received

05/12/04

Volatiles

Date Analyzed:

05/15/04

Analyst:

KLL

Method:

8260B

<u>Analyte</u>	<u>Results</u>	<u>Units</u>	<u>Reporting Limit</u>
Dichlorodifluoromethane	ND	µg/L	2
Chloromethane	ND	µg/L	2
Vinyl Chloride	ND	µg/L	2
Bromomethane	ND	µg/L	2
Chloroethane	ND	µg/L	2
Acetone	ND	µg/L	2
1,1-Dichloroethene	ND	µg/L	2
Methylene Chloride	ND	µg/L	2
Carbon Disulfide	ND	µg/L	2
Methyl Tert Butyl Ether (MTBE)	ND	µg/L	2
trans-1,2-Dichloroethene	ND	µg/L	2
1,1-Dichloroethane	ND	µg/L	2
2-Butanone (MEK)	ND	µg/L	2
cis-1,2-Dichloroethene	ND	µg/L	2
2,2-Dichloropropane	ND	µg/L	2
Bromochloromethane	ND	µg/L	2
Chloroform	ND	µg/L	2
1,1,1-Trichloroethane	ND	µg/L	2
1,1-Dichloropropene	ND	µg/L	2
Carbon Tetrachloride	ND	µg/L	2
1,2-Dichloroethane	ND	µg/L	2
Benzene	ND	µg/L	2
Trichloroethene	6.50	µg/L	2
1,2-Dichloropropane	ND	µg/L	2
Dibromomethane	ND	µg/L	2
Bromodichloromethane	ND	µg/L	2
2-Chloroethyl vinyl ether	ND	µg/L	2
cis-1,3-Dichloropropene	ND	µg/L	2
4-Methyl-2-pentanone (MIBK)	ND	µg/L	2
Toluene	ND	µg/L	2
trans-1,3-Dichloropropene	ND	µg/L	2
1,1,2-Trichloroethane	ND	µg/L	2
1,3-Dichloropropane	ND	µg/L	2
Tetrachloroethene	ND	µg/L	2
2-Hexanone	ND	µg/L	2
Dibromochloromethane	ND	µg/L	2
1,2-Dibromoethane	ND	µg/L	2
Chlorobenzene	ND	µg/L	2



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Certificate of Analysis

Client Project #: 36204/GSA Hardesty Federal Building

Laboratory Work Order #: 5067

Client Sample ID: GSA SP-5 GW-1

Lab Sample ID: 506702

Volatiles	Date Analyzed:	05/15/04	Analyst:	KLL	Method:	8260B
<u>Analyte</u>	<u>Results</u>		<u>Units</u>	<u>Reporting Limit</u>		
1,1,1,2-Tetrachloroethane	ND		µg/L	2		
Ethyl Benzene	ND		µg/L	2		
m/p Xylene	ND		µg/L	2		
o Xylene	ND		µg/L	2		
Styrene	ND		µg/L	2		
Bromoform	ND		µg/L	2		
Isopropyl benzene	ND		µg/L	2		
1,1,2,2-tetrachloroethane	ND		µg/L	2		
Bromobenzene	ND		µg/L	2		
1,2,3-Trichloropropane	ND		µg/L	2		
n-Propyl benzene	ND		µg/L	2		
2-Chlorotoluene	ND		µg/L	2		
1,3,5-Trimethyl benzene	ND		µg/L	2		
4-chlorotoluene	ND		µg/L	2		
tert Butyl benzene	ND		µg/L	2		
1,2,4-trimethyl benzene	ND		µg/L	2		
sec Butyl benzene	ND		µg/L	2		
1,3-Dichlorobenzene	ND		µg/L	2		
p-isopropyl toluene	ND		µg/L	2		
1,4-Dichlorobenzene	ND		µg/L	2		
n-Butyl benzene	ND		µg/L	2		
1,2-Dichlorobenzene	ND		µg/L	2		
1,2-Dibromo-3-chloropropane	ND		µg/L	2		
1,2,4-Trichlorobenzene	ND		µg/L	2		
Hexachlorobutadiene	ND		µg/L	2		
Naphthalene	ND		µg/L	2		
1,2,3-Trichlorobenzene	ND		µg/L	2		
Dibromofluoromethane (surrogate)	96		%			
1,2-Dichloroethane-d4 (surrogate)	83		%			
Toluene-d8 (surrogate)	103		%			
4-Bromofluorobenzene (surrogate)	88		%			



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Certificate of Analysis

Client Project #: 36204/GSA Hardesty Federal Building

Laboratory Work Order #: 5067

Client Sample ID: GSA SP-7 GW-2	Date Collected: 05/ /04
Lab Sample ID: 506703	Date Received: 05/12/04

Volatiles	Date Analyzed: 05/15/04	Analyst: KLL	Method: 8260B
Analyte	Results	Units	Reporting Limit
Dichlorodifluoromethane	ND	µg/L	2
Chloromethane	ND	µg/L	2
Vinyl Chloride	ND	µg/L	2
Bromomethane	ND	µg/L	2
Chloroethane	ND	µg/L	2
Acetone	ND	µg/L	2
1,1-Dichloroethene	ND	µg/L	2
Methylene Chloride	ND	µg/L	2
Carbon Disulfide	ND	µg/L	2
Methyl Tert Butyl Ether (MTBE)	ND	µg/L	2
trans-1,2-Dichloroethene	ND	µg/L	2
1,1-Dichloroethane	ND	µg/L	2
2-Butanone (MEK)	ND	µg/L	2
cis-1,2-Dichloroethene	ND	µg/L	2
2,2-Dichloropropane	ND	µg/L	2
Bromochloromethane	ND	µg/L	2
Chloroform	ND	µg/L	2
1,1,1-Trichloroethane	ND	µg/L	2
1,1-Dichloropropene	ND	µg/L	2
Carbon Tetrachloride	ND	µg/L	2
1,2-Dichloroethane	ND	µg/L	2
Benzene	ND	µg/L	2
Trichloroethene	ND	µg/L	2
1,2-Dichloropropane	ND	µg/L	2
Dibromomethane	ND	µg/L	2
Bromodichloromethane	ND	µg/L	2
2-Chloroethyl vinyl ether	ND	µg/L	2
cis-1,3-Dichloropropene	ND	µg/L	2
4-Methyl-2-pentanone (MIBK)	ND	µg/L	2
Toluene	ND	µg/L	2
trans-1,3-Dichloropropene	ND	µg/L	2
1,1,2-Trichloroethane	ND	µg/L	2
1,3-Dichloropropane	ND	µg/L	2
Tetrachloroethene	ND	µg/L	2
2-Hexanone	ND	µg/L	2
Dibromochloromethane	ND	µg/L	2
1,2-Dibromoethane	ND	µg/L	2
Chlorobenzene	ND	µg/L	2



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Certificate of Analysis

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Client Project #: 36204/GSA Hardesty Federal Building

Laboratory Work Order #: 5067

Client Sample ID: GSA SP-7 GW-2

Lab Sample ID: 506703

Volatiles	Date Analyzed:	05/15/04	Analyst:	KLL	Method:	8260B
Analyte	Results	Units	Reporting Limit			
1,1,1,2-Tetrachloroethane	ND	µg/L	2			
Ethyl Benzene	ND	µg/L	2			
m/p Xylene	ND	µg/L	2			
o Xylene	ND	µg/L	2			
Styrene	ND	µg/L	2			
Bromoform	ND	µg/L	2			
Isopropyl benzene	ND	µg/L	2			
1,1,2,2-tetrachloroethane	ND	µg/L	2			
Bromobenzene	ND	µg/L	2			
1,2,3-Trichloropropane	ND	µg/L	2			
n-Propyl benzene	ND	µg/L	2			
2-Chlorotoluene	ND	µg/L	2			
1,3,5-Trimethyl benzene	ND	µg/L	2			
4-chlorotoluene	ND	µg/L	2			
tert Butyl benzene	ND	µg/L	2			
1,2,4-trimethyl benzene	ND	µg/L	2			
sec Butyl benzene	ND	µg/L	2			
1,3-Dichlorobenzene	ND	µg/L	2			
p-isopropyl toluene	ND	µg/L	2			
1,4-Dichlorobenzene	ND	µg/L	2			
n-Butyl benzene	ND	µg/L	2			
1,2-Dichlorobenzene	ND	µg/L	2			
1,2-Dibromo-3-chloropropane	ND	µg/L	2			
1,2,4-Trichlorobenzene	ND	µg/L	2			
Hexachlorobutadiene	ND	µg/L	2			
Naphthalene	ND	µg/L	2			
1,2,3-Trichlorobenzene	ND	µg/L	2			
Dibromofluoromethane (surrogate)	95	%				
1,2-Dichloroethane-d4 (surrogate)	85	%				
Toluene-d8 (surrogate)	103	%				
4-Bromofluorobenzene (surrogate)	87	%				



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Phone: (913) 829-0101 • Fax: (913) 829-1181

Certificate of Analysis

Client Project #: 36204/GSA Hardesty Federal Building

Laboratory Work Order #: 5067

Client Sample ID: GSA SP-9 GW-1

Date Collected:

05/ /04

Lab Sample ID: 506704

Date Received

05/12/04

Volatiles

Date Analyzed:

05/15/04

Analyst:

KLL

Method:

8260B

<u>Analyte</u>	<u>Results</u>	<u>Units</u>	<u>Reporting Limit</u>
Dichlorodifluoromethane	ND	µg/L	2
Chloromethane	ND	µg/L	2
Vinyl Chloride	ND	µg/L	2
Bromomethane	ND	µg/L	2
Chloroethane	ND	µg/L	2
Acetone	ND	µg/L	2
1,1-Dichloroethene	ND	µg/L	2
Methylene Chloride	ND	µg/L	2
Carbon Disulfide	ND	µg/L	2
Methyl Tert Butyl Ether (MTBE)	ND	µg/L	2
trans-1,2-Dichloroethene	ND	µg/L	2
1,1-Dichloroethane	ND	µg/L	2
2-Butanone (MEK)	ND	µg/L	2
cis-1,2-Dichloroethene	ND	µg/L	2
2,2-Dichloropropane	ND	µg/L	2
Bromochloromethane	ND	µg/L	2
Chloroform	ND	µg/L	2
1,1,1-Trichloroethane	ND	µg/L	2
1,1-Dichloropropene	ND	µg/L	2
Carbon Tetrachloride	ND	µg/L	2
1,2-Dichloroethane	ND	µg/L	2
Benzene	ND	µg/L	2
Trichloroethene	ND	µg/L	2
1,2-Dichloropropane	ND	µg/L	2
Dibromomethane	ND	µg/L	2
Bromodichloromethane	ND	µg/L	2
2-Chloroethyl vinyl ether	ND	µg/L	2
cis-1,3-Dichloropropene	ND	µg/L	2
4-Methyl-2-pentanone (MIBK)	ND	µg/L	2
Toluene	ND	µg/L	2
trans-1,3-Dichloropropene	ND	µg/L	2
1,1,2-Trichloroethane	ND	µg/L	2
1,3-Dichloropropane	ND	µg/L	2
Tetrachloroethene	ND	µg/L	2
2-Hexanone	ND	µg/L	2
Dibromochloromethane	ND	µg/L	2
1,2-Dibromoethane	ND	µg/L	2
Chlorobenzene	ND	µg/L	2



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est. 1992
Tim Stecher

Burns & McDonnell

15130 South Keeler, Olathe, Kansas 66062
Phone: (913) 829-0101 • Fax: (913) 829-1181

Certificate of Analysis

Client Project #: 36204/GSA Hardesty Federal Building

Laboratory Work Order #: 5067

Client Sample ID: GSA SP-9 GW-1

Lab Sample ID: 506704

Volatiles	Date Analyzed:	05/15/04	Analyst:	KLL	Method:	8260B
<u>Analyte</u>	<u>Results</u>	<u>Units</u>	<u>Reporting Limit</u>			
1,1,1,2-Tetrachloroethane	ND	µg/L	2			
Ethyl Benzene	ND	µg/L	2			
m/p Xylene	ND	µg/L	2			
o Xylene	ND	µg/L	2			
Styrene	ND	µg/L	2			
Bromoform	ND	µg/L	2			
Isopropyl benzene	ND	µg/L	2			
1,1,2,2-tetrachloroethane	ND	µg/L	2			
Bromobenzene	ND	µg/L	2			
1,2,3-Trichloropropane	ND	µg/L	2			
n-Propyl benzene	ND	µg/L	2			
2-Chlorotoluene	ND	µg/L	2			
1,3,5-Trimethyl benzene	ND	µg/L	2			
4-chlorotoluene	ND	µg/L	2			
tert Butyl benzene	ND	µg/L	2			
1,2,4-trimethyl benzene	ND	µg/L	2			
sec Butyl benzene	ND	µg/L	2			
1,3-Dichlorobenzene	ND	µg/L	2			
p-isopropyl toluene	ND	µg/L	2			
1,4-Dichlorobenzene	ND	µg/L	2			
n-Butyl benzene	ND	µg/L	2			
1,2-Dichlorobenzene	ND	µg/L	2			
1,2-Dibromo-3-chloropropane	ND	µg/L	2			
1,2,4-Trichlorobenzene	ND	µg/L	2			
Hexachlorobutadiene	ND	µg/L	2			
Naphthalene	ND	µg/L	2			
1,2,3-Trichlorobenzene	ND	µg/L	2			
Dibromofluoromethane (surrogate)	99	%				
1,2-Dichloroethane-d4 (surrogate)	86	%				
Toluene-d8 (surrogate)	103	%				
4-Bromofluorobenzene (surrogate)	88	%				



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Laboratory: AML
Address: 1530 S. Keeler
City/State/Zip: Olathe, KS
Telephone: 913 829 9101

Lab. Reference No. or Episode No.: 5067

Attention: TIM STECHER

Project Number: 36204

Sample Type

Client Name: GSA - HARDESTY FEDERAL CENTER

Matrix

Sampler *(signature):*

TIM STECHER

Sampler (signature):

Special Instructions:

Relinquished By (signature):

Date/Time

Received By (signature):

Date/Time

Ice Present in Container:

Temperature Upon Receipt: _____

1. Tim Spruner

5/12/04/405

19-11-1950

05/12/15

Yes ☐ No ☐

Relinquished By (signature)

Date/Time

Received By (signature)

Date/Time

Laboratory Comments:



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Certificate of Analysis

June 11, 2004

Tim Stecher
Burns & McDonnell
9400 Ward Parkway
Kansas City, MO 64114
Phone: 333-9400
Fax: 822-3494

Client Project #: 36204/GSA Hardesty Federal Building

Laboratory Work Order #: 5079

Dear Mr. Stecher:

Included are the analytical results for the samples received on May 13, 2004. All analyses were prepared and analyzed within analytical holding time.

Data qualifiers are as follows:

- ND = Not detected at or above the reporting limit.
- B = Some level of the compound was present in the method blank.
- J = Compound results are an estimated concentration.
- E = Compound present in levels greater than the instrument calibration range.

If you have any questions regarding this report, please call me at (913) 829-0101.

Kendall L. Lindquist, MBA
Operations Manager



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Client Project #: 36204/GSA Hardesty Federal Building

Laboratory Work Order #: 5079

Client Sample ID:	Trip Blank	Date Collected:	05/13/04
Lab Sample ID:	507901	Date Received:	05/13/04

Volatiles	Date Analyzed:	05/26/04	Analyst:	KLL	Method:	8260B
Analyte	Results	Units	Reporting Limit			
Dichlorodifluoromethane	ND	µg/L	2			
Chloromethane	ND	µg/L	2			
Vinyl Chloride	ND	µg/L	2			
Bromomethane	ND	µg/L	2			
Chloroethane	ND	µg/L	2			
Acetone	ND	µg/L	2			
1,1-Dichloroethene	ND	µg/L	2			
Methylene Chloride	ND	µg/L	2			
Carbon Disulfide	ND	µg/L	2			
Methyl Tert Butyl Ether (MTBE)	ND	µg/L	2			
trans-1,2-Dichloroethene	ND	µg/L	2			
1,1-Dichloroethane	ND	µg/L	2			
2-Butanone (MEK)	ND	µg/L	2			
cis-1,2-Dichloroethene	ND	µg/L	2			
2,2-Dichloropropane	ND	µg/L	2			
Bromochloromethane	ND	µg/L	2			
Chloroform	ND	µg/L	2			
1,1,1-Trichloroethane	ND	µg/L	2			
1,1-Dichloropropene	ND	µg/L	2			
Carbon Tetrachloride	ND	µg/L	2			
1,2-Dichloroethane	ND	µg/L	2			
Benzene	ND	µg/L	2			
Trichloroethene	ND	µg/L	2			
1,2-Dichloropropane	ND	µg/L	2			
Dibromomethane	ND	µg/L	2			
Bromodichloromethane	ND	µg/L	2			
2-Chloroethyl vinyl ether	ND	µg/L	2			
cis-1,3-Dichloropropene	ND	µg/L	2			
4-Methyl-2-pentanone (MIBK)	ND	µg/L	2			
Toluene	ND	µg/L	2			
trans-1,3-Dichloropropene	ND	µg/L	2			
1,1,2-Trichloroethane	ND	µg/L	2			
1,3-Dichloropropane	ND	µg/L	2			
Tetrachloroethene	ND	µg/L	2			
2-Hexanone	ND	µg/L	2			
Dibromochloromethane	ND	µg/L	2			
1,2-Dibromoethane	ND	µg/L	2			
Chlorobenzene	ND	µg/L	2			



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Certificate of Analysis

Client Project #: 36204/GSA Hardesty Federal Building

Laboratory Work Order #: 5079

Client Sample ID: Trip Blank

Lab Sample ID: 507901

Volatiles	Date Analyzed:	05/26/04	Analyst:	KLL	Method:	8260B
Analyte	Results	Units	Reporting Limit			
1,1,1,2-Tetrachloroethane	ND	µg/L	2			
Ethyl Benzene	ND	µg/L	2			
m/p Xylene	ND	µg/L	2			
o Xylene	ND	µg/L	2			
Styrene	ND	µg/L	2			
Bromoform	ND	µg/L	2			
Isopropyl benzene	ND	µg/L	2			
1,1,2,2-tetrachloroethane	ND	µg/L	2			
Bromobenzene	ND	µg/L	2			
1,2,3-Trichloropropane	ND	µg/L	2			
n-Propyl benzene	ND	µg/L	2			
2-Chlorotoluene	ND	µg/L	2			
1,3,5-Trimethyl benzene	ND	µg/L	2			
4-chlorotoluene	ND	µg/L	2			
tert Butyl benzene	ND	µg/L	2			
1,2,4-trimethyl benzene	ND	µg/L	2			
sec Butyl benzene	ND	µg/L	2			
1,3-Dichlorobenzene	ND	µg/L	2			
p-isopropyl toluene	ND	µg/L	2			
1,4-Dichlorobenzene	ND	µg/L	2			
n-Butyl benzene	ND	µg/L	2			
1,2-Dichlorobenzene	ND	µg/L	2			
1,2-Dibromo-3-chloropropane	ND	µg/L	2			
1,2,4-Trichlorobenzene	ND	µg/L	2			
Hexachlorobutadiene	ND	µg/L	2			
Naphthalene	ND	µg/L	2			
1,2,3-Trichlorobenzene	ND	µg/L	2			
Dibromofluoromethane (surrogate)	101	%				
1,2-Dichloroethane-d4 (surrogate)	99	%				
Toluene-d8 (surrogate)	100	%				
4-Bromofluorobenzene (surrogate)	90	%				



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Certificate of Analysis

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Client Project #: 36204/GSA Hardesty Federal Building

Laboratory Work Order #: 5079

Client Sample ID:	GSA SP-8 GW-1	Date Collected:	05/13/04
Lab Sample ID:	507902	Date Received:	05/13/04

Volatiles	Date Analyzed:	05/26/04	Analyst:	KLL	Method:	8260B
<u>Analyte</u>	<u>Results</u>	<u>Units</u>	<u>Reporting Limit</u>			
Dichlorodifluoromethane	ND	µg/L	2			
Chloromethane	ND	µg/L	2			
Vinyl Chloride	ND	µg/L	2			
Bromomethane	ND	µg/L	2			
Chloroethane	ND	µg/L	2			
Acetone	ND	µg/L	2			
1,1-Dichloroethene	ND	µg/L	2			
Methylene Chloride	ND	µg/L	2			
Carbon Disulfide	ND	µg/L	2			
Methyl Tert Butyl Ether (MTBE)	ND	µg/L	2			
trans-1,2-Dichloroethene	ND	µg/L	2			
1,1-Dichloroethane	ND	µg/L	2			
2-Butanone (MEK)	ND	µg/L	2			
cis-1,2-Dichloroethene	ND	µg/L	2			
2,2-Dichloropropane	ND	µg/L	2			
Bromochloromethane	ND	µg/L	2			
Chloroform	ND	µg/L	2			
1,1,1-Trichloroethane	ND	µg/L	2			
1,1-Dichloropropene	ND	µg/L	2			
Carbon Tetrachloride	ND	µg/L	2			
1,2-Dichloroethane	ND	µg/L	2			
Benzene	ND	µg/L	2			
Trichloroethene	ND	µg/L	2			
1,2-Dichloropropane	ND	µg/L	2			
Dibromomethane	ND	µg/L	2			
Bromodichloromethane	ND	µg/L	2			
2-Chloroethyl vinyl ether	ND	µg/L	2			
cis-1,3-Dichloropropene	ND	µg/L	2			
4-Methyl-2-pentanone (MIBK)	ND	µg/L	2			
Toluene	ND	µg/L	2			
trans-1,3-Dichloropropene	ND	µg/L	2			
1,1,2-Trichloroethane	ND	µg/L	2			
1,3-Dichloropropane	ND	µg/L	2			
Tetrachloroethene	ND	µg/L	2			
2-Hexanone	ND	µg/L	2			
Dibromochloromethane	ND	µg/L	2			
1,2-Dibromoethane	ND	µg/L	2			
Chlorobenzene	ND	µg/L	2			



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Certificate of Analysis

Client Project #: 36204/GSA Hardesty Federal Building

Laboratory Work Order #: 5079

Client Sample ID: GSA SP-8 GW-1

Lab Sample ID: 507902

Volatiles	Date Analyzed:	05/15/04	Analyst:	KLL	Method:	8260B
Analyte	Results	Units	Reporting Limit			
1,1,1,2-Tetrachloroethane	ND	µg/L	2			
Ethyl Benzene	ND	µg/L	2			
m/p Xylene	ND	µg/L	2			
o Xylene	ND	µg/L	2			
Styrene	ND	µg/L	2			
Bromoform	ND	µg/L	2			
Isopropyl benzene	ND	µg/L	2			
1,1,2,2-tetrachloroethane	ND	µg/L	2			
Bromobenzene	ND	µg/L	2			
1,2,3-Trichloropropane	ND	µg/L	2			
n-Propyl benzene	ND	µg/L	2			
2-Chlorotoluene	ND	µg/L	2			
1,3,5-Trimethyl benzene	ND	µg/L	2			
4-chlorotoluene	ND	µg/L	2			
tert Butyl benzene	ND	µg/L	2			
1,2,4-trimethyl benzene	ND	µg/L	2			
sec Butyl benzene	ND	µg/L	2			
1,3-Dichlorobenzene	ND	µg/L	2			
p-isopropyl toluene	ND	µg/L	2			
1,4-Dichlorobenzene	ND	µg/L	2			
n-Butyl benzene	ND	µg/L	2			
1,2-Dichlorobenzene	ND	µg/L	2			
1,2-Dibromo-3-chloropropane	ND	µg/L	2			
1,2,4-Trichlorobenzene	ND	µg/L	2			
Hexachlorobutadiene	ND	µg/L	2			
Naphthalene	ND	µg/L	2			
1,2,3-Trichlorobenzene	ND	µg/L	2			
Dibromofluoromethane (surrogate)	100	%				
1,2-Dichloroethane-d4 (surrogate)	100	%				
Toluene-d8 (surrogate)	98	%				
4-Bromofluorobenzene (surrogate)	90	%				



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Laboratory: AML LABS
Address: 1530 S. KEELER
City/State/Zip: OLATHE, KS
Telephone: 913 829 0101

Lab. Reference No. or Episode No.: 8079-01

Project Number: 36204 HARDESTY FEDERAL CENTER

Sample Type

Client Name: GSA

Matrix

Sampler (signature):

Sampler (signature):

Special Instructions:

Relinquished By (signature):

Date/Time

Received By (signature):

Date/Time

Ice Present in Container:

Temperature Upon Receipt:

1. 1m STEAMER

5/13/04 11:10

[Signature]

113104
1105

Yes ☐ No ☐

Relinquished By *(signature)*

Date/Time

Received By (signature):

Date/Time

Laboratory Comments:

APPENDIX D
GEOTECHNOLOGY ANALYTICAL REPORT

LABORATORY TEST RESULTS
GSA Hardesty Complex

Boring No.	Sample No.	Depth (ft)		Gravimetric Water Content g/g	Volumetric Water Content cc/cc	Dry Bulk Density ¹ (g/cc)	Porosity ² cc/cc	Fractional Organic Carbon Content ³ (g/g)	Fractional Organic Matter Content (g/g)
		From	To	ASTM D2216	MRBCA 5.6.4	ASTM D2937	MRBCA 5.6.3	Modified Walkley Black	Modified Walkley Black
BH-1		8.0	12.0	0.265	0.419	1.581	0.586	0.001	0.002

¹ Based on a geoprobe sampler specimen

² An assumed specific gravity of 2.7 was used.

³ Test performed by Servi-Tech Laboratories, Dodge City, Kansas